Chinese Regional Agricultural Productivity: 20 Years After

Haizhi Tong\textsuperscript{1}
Lilyan E. Fulginiti\textsuperscript{2}
Juan P. Sesmero\textsuperscript{3}

\textsuperscript{1} PhD in Economics, University of Nebraska, USA.
\textsuperscript{2} Professor, Agricultural Economics Department, University of Nebraska, USA.
\textsuperscript{3} PhD Candidate in Agricultural Economics, University of Nebraska, USA.
China’s agricultural output increased ~ 200% since the 1978 HRS reforms.

Are Chinese rapid growth rate sustainable?

What is the main source of this growth?

Is it *scale* or is it *innovations*?

• **Important** because one implies long run growth while the other source does not
What is the evidence?

• Rapid increase in input use

• Adoption of new technologies

• Studies of the economy point towards scale
• 20 years after the HRS reforms of 1978

• Growth rates of ag output slowed down in the early 1990’s

• Was this additional evidence that most of the growth is scale based?

• Or is it that uncertainty due to potential of policy reform in 1998?

• Could this have affected agricultural productivity?
Other Studies of the 1990’s: Provincial Data

- Lambert: 1993-95, Tornquist Index, 5.8%
- Jin et al.: 1994-1995, Tornquist Index, -3.1%
- Meade: 1993-1995, Cobb-Douglas, 0.19%
- Tong and Fulg.: 1993-2001, Translog (1%) and MI (0.1%)
- Deckle et al.: 1994-2003, Cobb-Douglas, 6.58%
Objectives of this study:

• Examine *regional* agricultural productivity

• 29 Provinces (Tibet not included)

• Period 1993-2005

• 20 years after the 1978 reform

• Use China’s Statistical Yearbook data, not FAO

• Identify if differences in productivity across provinces are associated with *irrigation, education and public agricultural expenditures.*
Chronology of Major Ag. Policy Reforms:

1) 1978 HRS

2) 1994 elimination of food-rationing

3) 1995 Grain-Bag responsibility system

4) 1998 second HRS

5) 2003 elimination of taxes to sector
Data

• Output: agricultural output in real Yuans

• Four traditional inputs:
  Land (in ha)
  Agricultural machinery (in KW)
  Labor (persons)
  Fertilizer (tons)

• Three efficiency changing variables:
  Education (ratio)
  Irrigation (ratio)
  Public expenditures in agriculture (expenditures on agricultural water conservancy, meteorology, resource investigation, subsidies to well drilling, sprinkling irrigation projects and improved varieties)

• Source: China Statistical Yearbook
Figure 2: Series of Outputs and Inputs (FAO)
Percentage of irrigated cropland
Define productivity (TFP) as output per unit of input:

$$\text{TFP} = \frac{\text{Output Index}}{\text{Input Index}}$$

**TFP Growth rate**: Output growth - Input growth

*Concern* about using prices as weights
Methods

1) Malmquist Index:

\[
M_0(x_{t+1}, y_{t+1}, x_t, y_t) = \frac{D_0^{t+1}(x_{t+1}, y_{t+1})}{D_0^t(x_t, y_t)} \left[ \frac{D_o^t(x_{t+1}, y_{t+1})}{D_0^{t+1}(x_{t+1}, y_{t+1})} \cdot \frac{D_o^t(x_t, y_t)}{D_0^{t+1}(x_t, y_t)} \right]^{1/2}
\]

MI = Efficiency change + Technical change
2) Stochastic Production Frontier:

\[
\ln Y_{it} = \alpha_0 + \sum_m \alpha_m \ln x_{mit} + \alpha_t + \frac{1}{2} \sum_m \beta_{mn} \ln x_{mit} \ln x_{mit} + \frac{1}{2} \beta_{tt} t^2 + \sum_m \beta_{tm} \ln x_{mit} \ast t + v_{it} - u_{it}
\]

\[
TC_{it} = \frac{\partial \ln Y_{it}}{\partial t} = \alpha_t + \beta_{tt} t + \sum_m \beta_{tm} \ln x_{mit}
\]

\[
TE_{it} = \exp(-u_{it}) \quad u \sim HN(\mu, \sigma_u) \quad m_{it} = z_{it} \delta
\]

\[
TFP = \dot{y} - \sum_m \varepsilon_{m} \hat{x}_{m} = TC + EC
\]
Comparison of TFP Growth Rates for China, 1993-2005, MI and SPF (%)
Comparasion of average TFP indexes
China 1993-2005

Year

Value
1.1 1.2 1.3 1.4 1.5

Stochastic Frontier
Malmquist Index
Regional TFP Change Rate
1993-2005, MI (%)
Regional TFP Change Rate 1993-2005, Stochastic Frontier (%)
Regional Technical Change, SF
1993-2005
Rate of Technical Change by Region, MI, 1993-2005 (%)
TFP Growth Rates, SPF Different Period
Estimation of TFP for Different Periods SPF and MI
TFP growth rates, Malmquist
1993-2004 (%)
What factors affect differences in TFP rates?

• Irrigation - YES

• Education - YES

• Public Expenditures in Agriculture – YES
What else did we learn?

• Potential role of institutional change in reversal in 1998

• Important to use alternative approaches

• Specification error could drive results in particular when trend reversals are present

• Evolution of each province
Other Studies of the 1990’s: Provincial Data

- Lambert: 1993-95, Tornquist Index, 5.8%
- Jin et al.: 1994-1995, Tornquist Index, -3.1%
- Meade: 1993-1995, Cobb-Douglas, 0.19%
- Tong and Fulg.: 1993-2001, Translog (1%) and MI (0.1%)
- Deckle et al.: 1994-2003, Cobb-Douglas, 6.58%

- This study: 2%
• Output growth 1993-2005: 4.5%

• TFP Growth: 2%

   East: 3.2%
   Central: 1.6%
   West: 1.4%

Shifting the frontier: Quinhai, Beijing, Shanghai with TFP rates of 6-8% (cash crops, fruits and vegetables)

Traditional ag. areas TFP rates of 2-3% (Shizuan, Shangdong, Jiangsu, Guangdong, Henan, Hebei, Hunan, etc.)
• **East includes:** Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan.

• **Central includes:** Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan.

• **West includes:** Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xingjiang.
TFP Growth Rates, Stochastic Frontier, 1993-2005 (%)